if farmers and fruit-growers will club together in making their purchases. Such an arrangement will also save considerable in the way of transportation expenses.

	Per pound.		Per pound.
Copper carbonate	$0.60	Iron sulphate	$0.02
Copper sulphate	.08	Flowers of sulphur	.04
Potassium sulphide	.25	Alum	.03½
Aqua ammonia (22 Beaumé)	.08	Calcium chloride	.06
Sodium hyposulphite	.03	Aluminium sulphate	.05
Copper acetate	.30	Lime per barrel	2.00

NEW SPRAYING PUMP.

Ever since the work of the Section was inaugurated there has been felt the need of a cheap, serviceable, and effective apparatus for spraying grapes and all the low-growing crops. Heretofore we have had to rely mainly upon machines imported from France; in fact, with but one exception, the only pumps that have given satisfaction in our vineyard work have been purchased abroad. The average fruit-grower can not afford to send to France for a machine that will cost him, laid down in this country, all the way from $18 to $25, nor can he pay $21 for a pump made here, notwithstanding the fact that it is a most excellent machine and costs almost the selling price to manufacture it. In short, a knapsack pump, be it ever so serviceable, at $21 or even $18, is entirely beyond the reach of the average farmer, gardener, and fruit grower. Consequently he has to rely upon inferior machines, and, as a result, his treatments are frequently unsuccessful for the simple reason that the remedies are not properly applied.

We have had the matter of providing a cheap and serviceable knapsack pump under consideration for some time, and can now positively announce that the machine will be on the market in a few weeks. The pumps will be made in two or three styles, and as there will be no patent on them we hope manufacturers throughout the country will be able to offer them at about $12, thus placing them within the reach of all.

PREVENTION OF SMUT IN OATS AND OTHER CEREALS.

By W. A. Kellerman and W. T. Swingle.

The smuts of oats and other plants are minute vegetable parasites. They appropriate for their use the nourishment which the infected plant prepared for its own development, and in this way reduce its vitality or completely destroy the part attacked. The dark-colored powdery mass popularly called the smut is merely the mature fruit of the parasite, and consists of exceedingly minute reproductive bodies

called spores. These, when subjected to proper conditions, germinate by sending out a slender tube upon which small sporidia appear.

The smut arrives at maturity in case of oats when the latter are in bloom, and the spores, blown hither and thither, find their way into the flowers. The husks soon close over the young grain, and the spores which may have been thereby imprisoned remain dormant until the seed is planted in spring. The warmth and moisture cause the spores and the oats to germinate simultaneously. The slender tubes emitted by the spores now penetrate the delicate oat plants. Thereafter the smut plant grows concealed within its host until they both approach maturity. At this time the smut spores rapidly develop in the abortive head of oats and the black mass of smut becomes conspicuous.

It is sometimes claimed that smut in the soil, or in manure applied to the soil, will infect the young oat plants. This is certainly not the usual mode of infection and it may be doubted whether it ever occurs.

If the spores inclosed in the husks of the grain can be killed without injuring the seed, the smut can be perfectly prevented in the crop. This has usually been accomplished by soaking the seed in a solution of blue vitriol (copper sulphate). This process though destroying all or nearly all the smut, also injures the seed more or less. The hot-water method of Professor Jensen has proven thoroughly effectual in preventing smut and, besides, is not in the least injurious to the seed. In fact, both our own and Jensen's experiments show yields greater than would be expected from the mere prevention of the smut. We therefore recommend this treatment, which consists simply in immersing the infected seed in scalding water (132° Fahr.) for not less than five nor more than fifteen minutes, and immediately thereafter cooling it quickly by immersing in cold water.

In order to carry out this process satisfactorily when a large amount of seed is to be treated, two large vessels must be provided. These can be large kettles hung over a fire, or large boilers on a cook-stove. One vessel is to contain heated water (about 110° to 120° Fahr.) for the purpose of warming the seed preparatory to dipping into the second vessel. This second vessel is to contain water at a temperature of 132° to 135° F. Were not the seed warmed before dipping into the vessel of scalding water the temperature of the latter would be very much reduced, perhaps below 130°, and then the treatment would not be effectual. The seed, a half a bushel or more at a time, is to be placed in a coarsely-woven basket having a lining of wire netting with meshes fine enough to prevent the egress of the grains, say, twelve to the inch. A heavy wire bushel-basket may be used, or a light iron frame made over which the wire netting may be stretched. A lid or cover must be provided for, otherwise a portion of the seed will escape upon immersion. A sack made of coarsely woven cloth might be used instead of the basket, but it is much less convenient. It is necessary that the basket admit the water freely and immediately upon its immersion,

otherwise the treatment can not be expected to be effectual. An immersion of a few moments (less than a minute) will sufficiently warm the basket of seed, provided that it be lifted out then plunged in a time or two and shaken or revolved so that the water may come in contact with the grains. Then plunge it immediately into the second vessel, and with similar motion bring every grain into immediate contact with the scalding water. The lifting and plunging should be continued at short intervals until the seed is removed. In this way every portion of the seed will be subjected to the action of the scalding water. Immediately after its removal dash cold water over it or plunge it into a vessel of cold water and then spread out to dry. Another portion can be treated similarly, and so on till all of the seed has been disinfected.

The important precaution to be taken is as follows: *Maintain* the proper temperature of the water (132° Fahr.), in no case allowing it to rise higher than 135° or to fall below 130°. This will not be difficult to do if a reliable thermometer is used and hot or cold water be dipped into the vessel as the falling or rising temperature demands. Immersion fifteen minutes will not then injure the seed, though no doubt in a less time it will be thoroughly disinfected.

The seed can be treated any length of time before sowing. If it is to be stored it would be necessary to have it first thoroughly dried. If treated immediately before using it can be sowed broadcast when dried sufficiently to prevent adhesion of the grains, but for planting with the drill it would need perhaps to be more nearly dry.

The above outline of treatment is for oats, wheat, and rye. Professor Jensen has determined that barley must be previously soaked in cold water eight hours, otherwise the smut is not prevented.

It is to be remembered that this treatment if universal in any section of country will, besides preventing smut in the crop of the season, also insure clean seed for use the following year. It has been established by actual count that the smut often destroys a very large percentage of the crop. When the smut was reported to be inconsiderable or even absent, we have determined that there may be 5 to 15 per cent. of the heads smutted. These are at harvest time usually overlooked because the smut has been blown away and the inconspicuous naked and clean stalk only remains. It might be added in this connection that it has been established recently that the smuts of barley and wheat, though much resembling that of oats, are really different species.

Finally we may mention by way of suggestion for the benefit of others that farther experimentation is now being prosecuted, or about to be undertaken, having in view the determination of numerous points in connection with the application of fungicides for the prevention of smut. Among these are the following: A comparison of the efficacy under varying conditions of the hot-water treatment with other fungicides; comparison as to increase of yield when this or any other fungicides are used; trial of the Jensen method with other plants besides oats and

wheat, as barley, rye, grasses, millet, and maize; and the determination of the most favorable form of treatment, particularly with reference to the degree of temperature required, the duration of the immersion in hot water, and the mode of cooling.

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OBSERVATIONS ON THE DEVELOPMENT OF SOME FENESTRATE SPORIDIA.

(Plates I & II.)

BY CHARLES E. FAIRMAN.

The following notes have been made on the development of the sporidia in *Fenestella amorpha*, E. & E.,* and in *Patellaria fenestrata*, C. & P.,† A few comparisons have been made with the spore development of *Camarosporium subfenestratum*, B. & C.

In *Fenestella amorpha* we find the first stage of sporidial development to be represented by the formation of a finely granular protoplasmic layer, in the interior of the ascus. Numerous spherical drops may also be seen a little later in this condensed protoplasmic layer. This layer was not seen to impinge upon the walls of the ascus at any point.

A light-colored homogeneous fluid occupied the space between this layer and the walls of the ascus. Also it was noted that the granular layer did not touch the walls of the ascus at the top or apex. At first this layer appears quite homogeneous. We have designated it the *Sporidiogenic layer* (Fig. 1, plate I).

The sporidiogenic layer is generally broader at the apex of the ascus and narrows somewhat towards the base. In *Patellaria fenestrata* the same general characteristics of this layer will be found to exist. In this species the sporidiogenic layer is at times continuous with the base of the ascus, a condition of affairs which was not made out in the case of *Fenestella* (Fig. 14, plate II).

The next feature observed in the development was the formation of larger spherical bodies in the interior of the sporidiogenic layer. These spherical bodies are the first indications of the forming sporidia (Figs. 2, 3, and 4, Plate I, and Figs. 15 and 16, Plate II). In *Fenestella amorpha* the number generally found was 8, and in *Patellaria fenestrata* 4 (although more may be occasionally seen in the latter). As mentioned above, the general outline is spherical, and they seem to be placed at nearly equal distances apart, in number corresponding to the sporidia commonly found in the ascus of the species under consideration. They are the forming or immature sporidia. Nuclei next make

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*Journ. Mycol., Vol. IV, p. 58. †28th Report N. Y. State Mus., p. 68.